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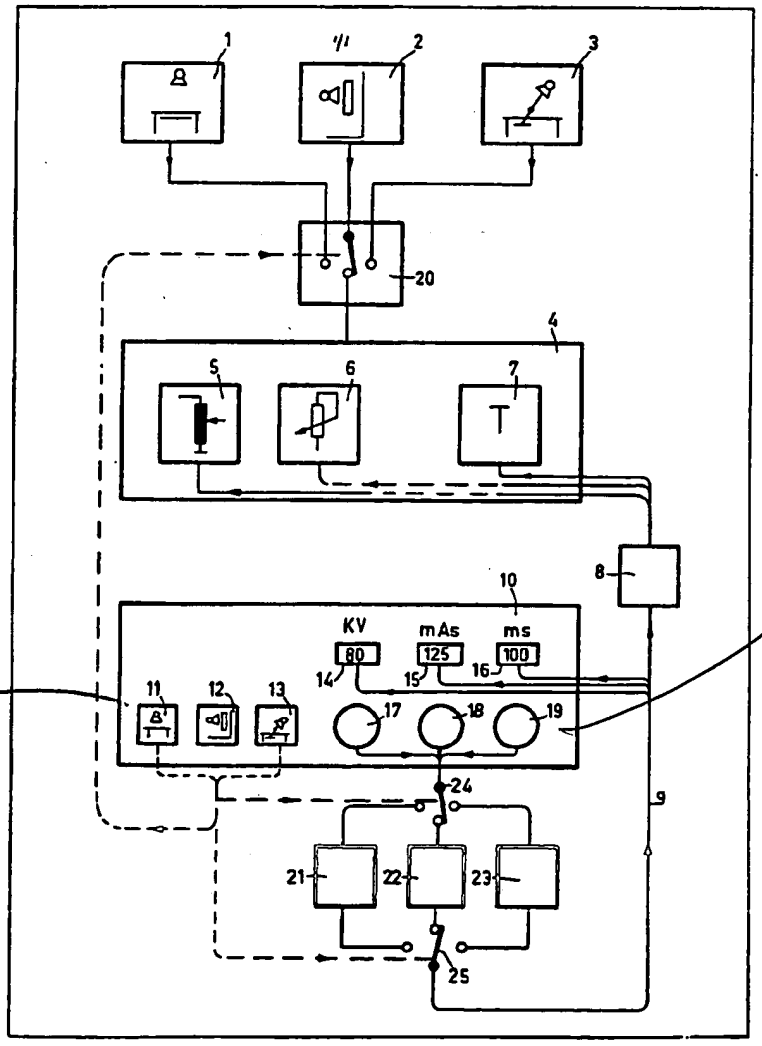
(54) **Radiographic apparatus**

(57) In an X-ray generator assembly, a group of various X-ray devices, e.g. a Bucky table 1, fluoroscopy apparatus 2, and tomography apparatus 3, are selectively connected, one at a time, to a power supply unit 4 by a switch 20 actuated by a device selector 11, 12, 13, and manual controls 17, 18, 19 can be used to set exposure parameters which are stored preporatory to making an exposure. Respective stores 21, 22, 23, are allocated to corresponding X-ray devices 1, 2, 3, and selected by switches 24, 25 actuated by the device selector 11, 12, 13. For example, actuation of the key 12 selects the device 2 and values stored in the store 22 are applied via a digital control unit 8 to control adjustment members 5, 6, 7 for h.t. voltage, tube current, and duration, in the power unit 4. A subsequent displacement of a manual control 17, 18, 19, causes a newly adjusted value to be written and stored in the selected store 22.



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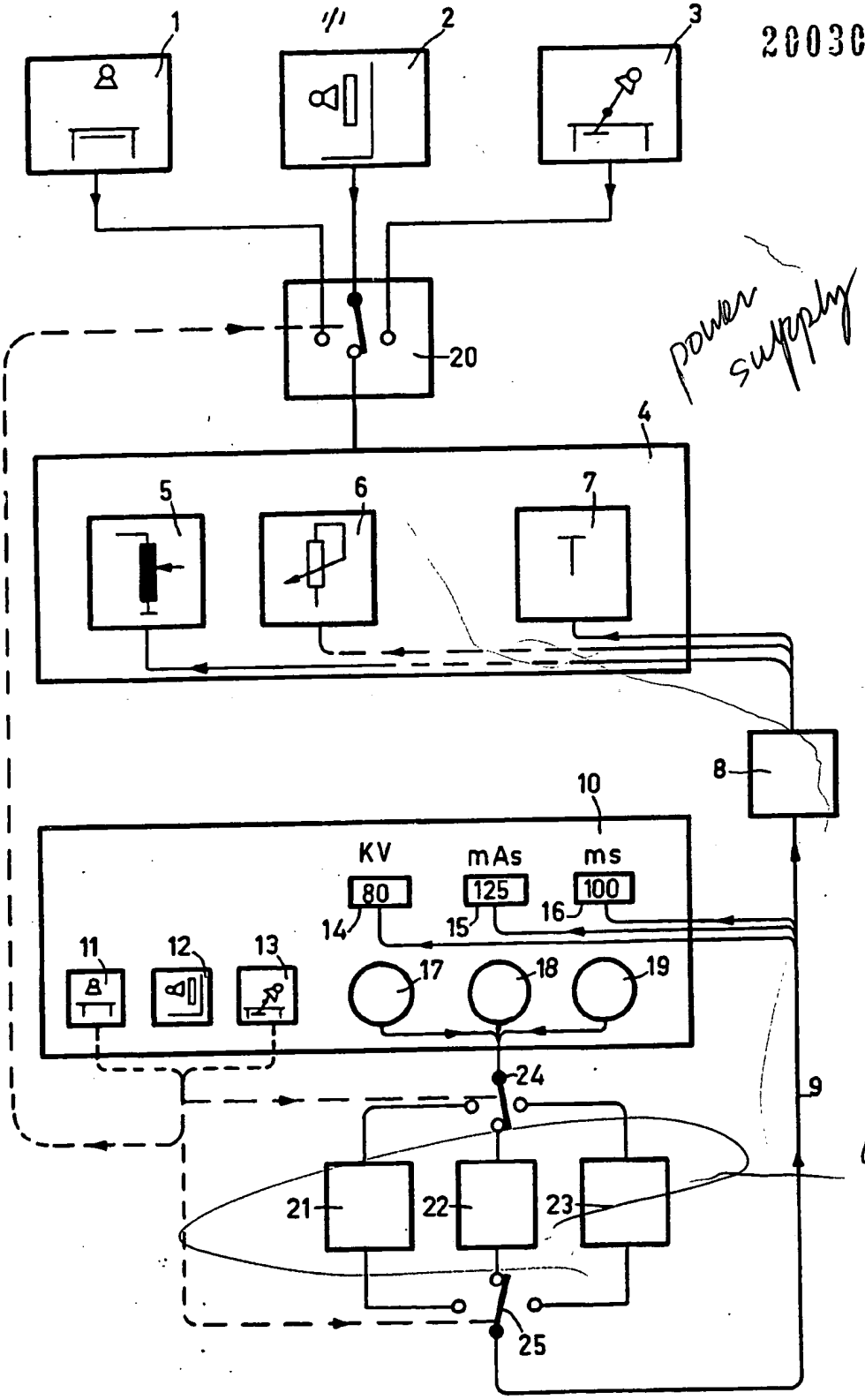

SPECIFICATION

X-ray generator assembly

The invention relates to an X-ray generator assembly, comprising at least one power supply unit to which any one of a plurality of associated X-ray examination devices, each including an X-ray source, can be selectively connected by X-ray device selection means, a control desk common to at least some of said X-ray examination devices and including manually operated adjustment means for adjusting exposure parameters for a selected said associated X-ray examination device, storage means for storing the exposure parameters for an X-ray exposure, and controllable adjustment means controlled by the contents of said storage means to control the selected combination of power supply unit and X-ray examination device in response to exposure parameters applied to the manually operated adjustment means and stored in said storage means. Such an assembly will be referred to herein as an X-ray generator assembly of the kind specified.

An X-ray generator assembly of this kind has been proposed in German Offenlegungsschrift 2,318,367. The storage means comprise separate memories, or parts of a memory, which store a set of exposure parameters associated with an X-ray recording of a given organ or part of the body. The contents of such a memory can be retrieved by operation of a key which is identified by a symbol for the relevant organ applied thereto, or by a corresponding numerical reference.

In known X-ray generators arranged to provide this exposure technique, sometimes called "programmed exposure technique", the storage of a set of exposure parameters generally cannot be performed by the operator himself, but can only be carried out by a service-technician. In an X-ray generator assembly of the kind described in the preamble, it has sometimes been arranged that the operator himself can load such sets of exposure parameters, after having adjusted the exposure parameters by means of manually operated adjustment members, by depressing an additional memory key. Subsequently, the exposure parameters stored can be retrieved in known manner. An X-ray exposure using these exposure parameters is then performed by that X-ray examination device selected by the operator using the X-ray device selection means.

Generally, the operator will only utilize this facility for assigning a set of exposure parameters to a given organ-related key if he wishes to assign such a set of exposure parameters to that key for a prolonged period of time. In clinical practice, however, it often happens that different operators have to work at the same time with different X-ray examination devices forming part of the assembly without utilizing the pre-programmed organ-related exposure data already stored, since they prefer to adjust the exposure parameters for themselves by means of the manually operated adjustment members (sometimes called the free adjustment technique). Once an operator has adjusted a set of exposure parameters in this way, it is sometimes necessary, before the X-ray exposure can be started, for other activities required for the examination to be performed, for example, the administration of a contrast medium to the patient or, in the case of a conventional tomorgraphy apparatus, an adjustment of the location of the sectional layer to be reproduced. It may then happen that in the meantime, another operator wishes to make an X-ray exposure using either the programmed or the free adjustment technique with one of the other X-ray examination devices in the assembly. The X-ray device selection means will then be actuated by the second operator to select the X-ray examination device required by him, and he will then either select a predetermined exposure program or reset the exposure parameters to the values he requires by using the manually operated adjustment members. The values of the exposure parameters set by the first operator will then be erased and lost.

This could in principle be avoided by arranging for the operator, in the case of the free adjustment technique, to assign the manually adjusted values of the exposure parameters directly to a relevant-organ key by operating that key and the memory key simultaneously, but this would be complicated and in many cases, namely if no other adjustments were in the meantime to be executed by another operator, unnecessary; moreover, the attention of the operator would be diverted from the patient, because he would have to remember which organ-related key he had assigned to the exposure data he had set.

The invention has for an object to provide an improved X-ray generator assembly in which the storage and retrieval of freely adjusted exposure parameters can be substantially simplified. According to the invention there is provided an X-ray generator assembly, comprising at least one power supply unit to which any one of a plurality of associated X-ray examination devices, each including an X-ray source, can be selectively connected by X-ray device selection means, a control desk common to at least some of said X-ray examination devices and including manually operated adjustment means for adjusting exposure parameters for a selected said associated X-ray examination device, storage means for storing the exposure parameters for an X-ray exposure, and controllable adjustment means controlled by the contents of said storage means to control the selected combination of power supply unit and X-ray examination device in response to the exposure parameters applied to the manually operated adjustment means and stored in said storage means, characterized in that each X-ray examination device has associated with it a corresponding storage location in said storage means, which is correspondingly selected and activated by said X-ray device selection means to control the controllable adjustment means in response to adjustment values stored therein, and, in response to a subsequent adjustment displacement of the manually operated adjustment means, to store subsequently adjusted values of the exposure parameters therein.

Therefore, in an embodiment of the invention, a portion of the storage means in the form of a memory, or a part of a memory (and only this one mem-

ory or this one part), is permanently assigned to each X-ray examination device, and this memory, or part of a memory, is automatically addressed when the relevant X-ray examination device is selected by means of the X-ray device selection means. When a manually operated adjustment member is operated while carrying out the free adjustment technique, the newly adjusted exposure parameters are arranged to be automatically stored in the associated addressed memory, so that the operator need not perform any additional operation in order to store the readjusted values of the exposure parameters. If subsequently another operator readjusts the exposure parameters to other values for application to another X-ray examination device selectable from the common control desk before the first operator can carry out his exposure, the latter merely has to reselect his X-ray examination device by means of the X-ray device selection means, which he would have to do anyway to connect the power supply to the selected X-ray device. The memory location associated with the reselected examination device is then automatically activated, *i.e.* the contents of this memory is used to control controllable adjustment members which form part of the power supply unit.

An embodiment of the invention will now be described by way of example, with reference to the accompanying diagrammatic drawing, the single figure of which illustrates an embodiment of the invention.

The references 1, 2, 3 in the drawing denote three X-ray examination devices for making different kinds of X-ray exposures, *i.e.* a Bucky table 1, a fluoroscopy apparatus 2 for making lung exposures, and a tomography apparatus 3. Each X-ray examination device includes an X-ray radiator, only one of which can be connected to a power supply unit 4 by means of a high voltage switch 20 at any instant. The high voltage switch 20 is controlled by X-ray device selection means which can comprise, for example, an assembly of keys 11, 12 and 13 which are arranged on a control desk 10 and which are mechanically and/or electrically interlocked with respect to each other, said keys being provided with the identifying symbols relating to the relevant X-ray examination device.

The power supply unit 4 supplies the selected X-radiator with the desired tube current, and adjusted high voltage, and for this purpose comprises a high voltage generator (not shown) and a plurality of controllable adjustment members, only the adjustment members 5, 6 and 7 being shown in the drawing; these members respectively serve to adjust the tube voltage (for example, by means of a variable transformer), to adjust the tube current (for example, by means of a resistor in a filament circuit), and to adjust the switch-on duration T by means of a timer. The controllable adjustment members 5, 6, 7, are controlled by a control unit 8 which converts digital signals on a line 9, originating from a memory and representing the exposure parameters to be set, into control signals for actuating the adjustment members 5, 6, 7. The exposure parameters passed along the line 9 are also indicated on indicators 14, 15 and 16 which are arranged on a central control desk 10. For the free adjustment of the exposure parameters, for example, the current, mAs product, switch-on duration, density, manually operated adjustment members are provided, only three of which (17 . . . 19) are shown in the drawing. Each manually operated adjustment member supplies a digital signal which is characteristic of the corresponding exposure parameter. These members can be realized, for example, in the form of a keyboard or a bank of switches, part of which may be common to the various parameters, for example numeral keys. The part of the X-ray generator assembly described thus far is similar to that disclosed in, for example, see German Offenlegungsschrift 2,318,367 and German Offenlegungsschrift 2,311,211.

In the present embodiment of the invention, there are provided three memories 21, 22, 23, one for each X-ray examination device, for the storage of freely adjusted exposure parameters. Memory selection switches 24 and 25 are actuated by the X-ray device selection means (11 . . . 13), and respectively connect the input of a selected one of the memories 21 to 23 to the manually operated adjustment members 17 to 19, and the output of the selected one of the memories 21 to 23 to the line 9. Thus, only one memory is activated at a time by the X-ray device selection means 11, 12, 13. The digital values of the exposure parameters supplied by the adjustment members 17 to 19, are thus stored in the activated memory. This can be effected, for example, by causing a displacement of any one of the manual adjustment members 17 to 19 to generate a write instruction which is applied to the write input of the activated memory. The fresh values thus stored in the memory are then made available at the memory output and hence on the line 9 (only one line 9 is shown, however, this line 9 can consist of a large number of individual lines for parallel operation).

In practice, use would not be made of a separate memory for each X-ray examination device for the storage of manually set values of the exposure parameters, but a single memory device or assembly would be used and a corresponding predetermined part of the memory i.e. a predetermined addressable storage region, would be associated with each X-ray examination device. Such a memory would not normally be activated directly by means of a mechanical switch but, for example, by means of a memory control device which supplies, in the present embodiment, one of three different addresses, each corresponding to the selected X-ray examination device, in dependence on the selection state of the X-ray device selection means 11 to 13, said address being associated with the corresponding predetermined storage region, i.e. the section of the memory, associated with the selected X-ray examination device. The exposure parameters fed in *via* the manually operated adjustment members 17 to 19 are stored in the addressed storage region, and the contents of this section of the memory controls, *via* the line 9 and the control unit 8, the controllable adjustment members 5 to 7.

If an operator wishes to perform an examination, for example, by means of the X-ray examination device 1, he will adjust the X-ray device selection

means accordingly, *i.e.* the operator will depress the device selection key 11. The power supply unit 4 will then be switched to supply the radiator of the X-ray examination device 1 by the resulting operation of the switch 20, and at the same time the memory 21 associated with this X-ray examination device will be activated, for example, by the corresponding displacement of the contacts 24, 25 or by the generation of the correct address instruction by a memory control device. The exposure parameters subsequently fed in by the operator *via* the manually operated adjustment members 17 to 19, will be stored in the memory 21 and will also be supplied from the output of the memory 21 to control the indicators 14 to 16 and the control unit 8 which controls the controllable adjustment members 5 to 7. If, after storing the exposure parameters in the memory device 21 but before an X-ray exposure is carried out, another operator wishes to use a different X-ray examination device, for example, the tomography apparatus 3, the latter operator operates the corresponding device selection key 13 of the X-ray device selection means, with the result that the memory section 23 is addressed and activated to store exposure parameters fed in by the latter operator, *via* the manually operated adjustment means 17, 18, 19, thus also controlling the indicators 14 to 16 and, *via* the control unit 8, the controllable adjustment members 5 to 7. If the operator who had previously selected exposure parameters for the X-ray examination device 1, subsequently wishes to perform an exposure using the previously adjusted exposure parameters, he need not feed these parameters in again, but merely has to operate the relevant device selection key 11 of the X-ray device selection means, which he would have to do anyway to connect the device 1 to the power supply unit 4, after which the indicators 14 to 16, and the controlled adjustment members 5 to 7, will be appropriately controlled by the contents of the memory section 21.

It is not necessary for the actuating elements of the X-ray device selection means to be located only on the central control desk 10. For example, each X-ray examination device may have associated with it a corresponding selection key which, when operated, ensures that the relevant examination device is connected to the power supply unit 4.

The invention can also be utilized in an X-ray generator assembly when use is made of several power supply units provided that the number of X-ray examination devices is greater than the number of power supply units.

For example, the invention can be used in an X-ray generator assembly employing two or more control desks, each control desk being common to some of the X-ray examination devices making up the assembly, and including corresponding manually operated adjustment means for adjusting exposure parameters for a selected X-ray examination device associated with that control desk.

Furthermore, additional memories may be provided for the so-termed "programmed exposure technique", the content of said memories being retrieved each time by operation of a program key associated with the memory in which the freely adjusted exposure parameters can be stored in known manner (German Offenlegungsschrift 2,318,367) by the simultaneous operation of the relevant program key and of an additional memory key.

CLAIMS

1. An X-ray generator assembly, comprising at least one power supply unit to which any one of a plurality of associated X-ray examination devices, each including an X-ray source, can be selectively connected by X-ray device selection means, a control desk common to at least some of said X-ray examination devices and including manually operated adjustment means for adjusting exposure parameters for a selected said associated X-ray examination device, storage means for storing the exposure parameters for an X-ray exposure, and controllable adjustment means controlled by the contents of said storage means to control the selected combination of power supply unit and X-ray examination device in response to the exposure parameters applied to the manually operated adjustment means and stored in said storage means, characterized in that each X-ray examination device has associated with it a corresponding storage location in said storage means, which is correspondingly selected and activated by said X-ray device selection means to control the controllable adjustment means in response to adjustment values stored therein, and, in response to a subsequent adjustment displacement of the manually operated adjustment means, to store subsequently adjusted values of the exposure parameters therein.

2. An X-ray generator assembly substantially as herein described with reference to the accompanying drawing.

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